Hydroponics

Hydroponics includes standards that challenge students to plan for future food needs using advanced technologies and less space. Soilless media are becoming increasingly important as populations grow and farmland is consumed by urban growth. Understanding how the benefits of hydroponics blend with environmental conservation is important as we enter the 21st century.

Pre-requisite: **Any fundamental course in Horticulture Sub-cluster**

Recommended Credit: **½ or 1**

Recommended Grade Levels: **10th, 11th or 12th**

***** **½ denotes learning expectations that must be met when teaching the course for ½ credit.**

****** **All learning expectations must be met when teaching the course for 1 credit.**

Hydroponics

Standard 1.0

The student will assess the effects of the history of hydroponics as it relates to current crop production.

Standard 2.0

The student will evaluate factors to consider in establishing a hydroponics greenhouse facility.

Standard 3.0

The student will discuss the uses for different hydroponics growing media.

Standard 4.0

The student will compare the advantages of the top commercial hydroponics crops and other crops that may successfully be grown using the hydroponics process.

Standard 5.0

The student will discuss the nutritional requirements for hydroponics plant growth.

Standard 6.0

The student will develop and implement an integrated pest management program for hydroponics plants.

Standard 7.0

The student will assess business skills needed to successfully operate a hydroponics facility.

Standard 8.0

The student will evaluate the use of innovative technologies in aquaponic and aeroponic production.

Standard 9.0

The student will integrate academic competencies in hydroponics.

Standard 10.0

The student will develop premier leadership and personal growth in the area of hydroponics crop production.

Hydroponics

Course Description:
This course is an intermediate level horticulture course designed to evaluate the basic techniques used for hydroponics crop production. These techniques involved the use of soilless media to produce vegetable and fruit products for market. Students will assess the importance of water quality, nutrient uptake and environmental conditions on the growth and production of various crops.

Standard 1.0

The student will assess the effects of the history of hydroponics as it relates to current crop production.

Learning Expectations:
The student will:

1.1 Discuss past developments leading to modern hydroponics production techniques. ½
1.2 Examine why hydroponics greenhouse vegetable production is becoming mainstream agriculture. ½
1.3 Analyze why hydroponics crop production is more prevalent in other countries than the United States. ½

Evidence Standard is Met
The student will:

- Specify important events and changes leading to modern hydroponics technology.
- Discuss reasons why there is an increase in hydroponics vegetable production.
- Describe why other countries such as Holland and England have more acreage in hydroponics than the United States.

Integration/Linkages
Science, Social Studies, Language Arts, Government, Business, Marketing, Horticulture Industry Standards, SCANS (Secretary's Commission on Achieving Necessary Skills)

Sample Performance Tasks

- Create a retrospective timeline of hydroponics technology changes, which have occurred over the last 100 years.
- Develop a list of reasons why United States hydroponics production is on the increase.
- Develop comparisons between U.S. and foreign hydroponics production.
- Debate the importance of hydroponics in feeding the world's growing population.

Standard 2.0

The student will evaluate factors to consider in establishing a hydroponics greenhouse facility.

Learning Expectations:
The student will:

2.1 Evaluate suitable hydroponics site characteristics.
2.2 Compare the advantages and disadvantages of various greenhouse structures.
2.3 Discuss different greenhouse controls and operating systems.
2.4 Describe the basic hydroponics equipment and tools used in a greenhouse.
2.5 Discuss the possible applications and uses of emerging technologies as it relates to hydroponics production.

Evidence Standard is Met:
The student will:

- Recommend hydroponics sites based on desirable site characteristics.
- Recommend the appropriate types of greenhouse structures for hydroponics use.
- Discuss the advantages and disadvantages of various greenhouse structures.
- Describe types of greenhouse control systems.
- Identify and discuss different types of hydroponics equipment.

Integration/Linkages
Mathematics, Physics, Language Arts, Horticulture Industry Standards, Technology Education, SCANS (Secretary's Commission on Achieving Necessary Skills), OSHA Standards, TOSHA Standards

Sample Performance Tasks

- Prepare a drawing of a selected site scenario for a hydroponics greenhouse.

- Sketch basic greenhouse structure types or designs.
- Program a greenhouse control system.
- Lay out a sample tomato production system.
- Write a paper on the application of emerging technology as it applies to hydroponics crop production.

Standard 3.0

The student will discuss the uses for different hydroponics growing media.

Learning Expectations:

The student will:

3.1	Compare the advantages and disadvantages of crops grown in the nutrient film techniques (NFT).	½
3.2	Compare the advantages and disadvantages of crops grown in rockwool bag culture.	½
3.3	Compare the advantages and disadvantages of crops grown in perlite bag culture.	½
3.4	Compare the advantages and disadvantages of crops grown in wood-based growing medium.	½
3.5	Compare the advantages and disadvantages of crops grown in gravel and sand based growing medium.	½
3.6	Compare the advantages and disadvantages of crops grown in other soilless cultures.	½

Evidence Standard is Met:

The student will:

- Determine the advantages and disadvantages of nutrient film technique systems.
- Discuss the advantages and disadvantages of rockwool bag culture.
- Compare the advantages and disadvantages of all other hydroponics growing mediums.

Integration/Linkages

Mathematics, Biology, Chemistry, Language Arts, Business, Marketing, Horticulture Industry Standards, SCANS (Secretary's Commission on Achieving Necessary Skills)

Sample Performance Tasks

- Calculate water-holding capacity of different mediums.
- Evaluate plant root growth in each type of medium.
- Discuss the different types of crops that could be grown in each system.

Standard 4.0

The student will compare the advantages of the top commercial hydroponics crops and other crops that may successfully be grown using the hydroponics process.

Learning Expectations:

The student will:

4.1	Discuss the techniques utilized in producing hydroponics tomatoes.	½
4.2	Describe the techniques used in producing a crop of hydroponics cucumbers.	½
4.3	Evaluate the techniques used in producing a hydroponics lettuce crop.	½
4.4	Discuss the techniques used in producing a hydroponics pepper crop.	
4.5	Describe the techniques used in producing a hydroponics herb crop.	
4.6	Discuss the techniques used in producing various other hydroponics crops.	

Evidence Standard is Met

The student will:

- Discuss equipment needed in raising hydroponics crops.
- Describe techniques used in raising hydroponics crops.
- Provide structural layouts for producing hydroponics crops.

Integration/Linkages

Mathematics, Science, Language Arts, Business, Marketing, Horticulture Industry Standards, SCANS (Secretary's Commission on Achieving Necessary Skills)

Sample Performance Tasks

- Present a sample layout of selected hydroponics crops and production techniques.

Standard 5.0

The student will discuss the nutritional requirements for hydroponics plant growth.

Learning Expectations:

The student will:

5.1	Evaluate the sixteen basic elements considered essential for the growth of hydroponics plants.	½
5.2	Discuss the different nutrient requirements for specific hydroponics crops.	½
5.3	Describe the functions of elements within the plant.	½
5.4	Identify nutrient deficiencies on plants.	½
5.5	Measure the levels of nutrients in solutions used for crops.	½
5.6	Measure and modify the pH of nutrient solutions.	½

Evidence Standard is Met:

The student will:

- Discuss the nutrient requirements for growth of hydroponics plants.
- Discuss and compare how nutrient requirements differ for specific crops.
- Discuss how the absence of an element shows up as a nutrient deficiency.
- Compare the effects of different nutrient deficiencies in plants.
- Demonstrate the use of an EC meter by measuring the EC of a solution and calculating nutrients or water to be added to obtain a certain nutrient level.
- Read and measure the correct pH of a solution.

Integration/Linkages

Mathematics, Biology, Chemistry, Language Arts, Horticulture Industry Standards, SCANS (Secretary's Commission on Achieving Necessary Skills)

Sample Performance Tasks

- Conduct experiments on plants, showing the effect of various nutrient combinations on plant growth.
- Create a pictorial chart showing the effects of nutrient deficiencies on plants.
- Measure the nutrient level in solutions using an EC meter.
- Measure the pH of a solution using a Fisher pH test kit or other pH-measuring device

Standard 6.0

The student will develop and implement an integrated pest management program for hydroponics plants.

Learning Expectations:

The student will:

6.1	Compare the effects of the major pests affecting hydroponics crops.
6.2	Discuss integrated pest management techniques.
6.3	Apply the basic concepts of pesticide safety.
6.4	Evaluate the different chemical methods of hydroponics pest control.
6.5	Compare common biological pest control methods for hydroponics crops.

Evidence Standard is Met:

The student will:

- Predict possible damage caused by the major pests affecting hydroponics crops.
- Describe the seven types of integrated pest control techniques.
- Demonstrate basic pesticide safety.
- Recommend biological control methods and chemical control methods for hydroponics production.

Integration/Linkages

Science, Mathematics, Language Arts, Social Studies, Horticulture Industry Standards, OSHA Standards, TOSHA Standards, SCANS (Secretary's Commission on Achieving Necessary Skills)

Sample Performance Tasks

- Prepare flashcards of major hydroponics pests.
- Create scenarios on appropriate approaches to control a pest problem.
- Prescribe safety procedures for proper pesticide handling and application.
- Propose biological controls and chemical controls for different pests.

Standard 7.0

The student will assess business skills needed to successfully operate a hydroponics facility.

Learning Expectations:

The student will:

7.1 Evaluate the basic business principles of supply and demand. ½
7.2 Demonstrate sales and marketing techniques necessary to run a successful business.
7.3 Demonstrate record keeping and financial management skills showing profit-loss ratios.
7.4 Demonstrate favorable supervisory skills necessary to manage a hydroponics operation.

Evidence Standard is Met:

The student will:

- Discuss how the principles of supply and demand affect hydroponics production.
- Recommend appropriate sales and marketing techniques for hydroponics products.
- Provide data on income and expenses for a hydroponics greenhouse.
- Participate in a role-play situation demonstrating supervisory skills necessary to manage a successful operation.

Integration/Linkages

Mathematics, Language Arts, Government, Business, Marketing, Horticulture Industry Standards, SCANS (Secretary's Commission on Achieving Necessary Skills)

Sample Performance Tasks

- Explain the principles of supply and demand.
- Present income and expense statements for the purpose of obtaining financing to start a hydroponics business.
- Create a skit to demonstrate successful sales and marketing techniques.
- Create an advertising campaign for hydroponics produce.
- Role-play an employee/employer interaction involving praise and criticism.

Standard 8.0

The student will evaluate the use of innovative technologies in aquaponic and aeroponic production.

Learning Expectations:

The student will:

8.1 Evaluate the basic requirements for fish production.
8.2 Evaluate the basic requirements for hydroponics plant production. ½
8.3 Integrate fish and plants into a symbiotic production system.
8.4 Demonstrate symbiotic engineering operations.
8.5 Evaluate aeroponic production techniques.

Evidence Standard is Met:

The student will:

- Determine the basic requirements for fish production in a greenhouse.
- Prescribe the basic system requirements for hydroponics plant production.
- Diagram a simple setup of an integrated hydroponics and aquaculture system.
- Describe how the symbiotic systems of fish and plants work to the benefit of both fish and plants.
- Describe various aeroponic production techniques.

Integration/Linkages

Biology, Chemistry, Mathematics, Language Arts, Horticulture Industry Standards, SCANS (Secretary's Commission on Achieving Necessary Skills)

Sample Performance Tasks

- Present a plan for meeting the requirements for growing fish in a greenhouse.
- Present a plan for meeting the requirements for hydroponics plant production.
- Create a symbiotic relationship by drawing and listing all materials needed to set up an aquaponics system.

Standard 9.0

The student will integrate academic competencies in hydroponics.

Mathematics:

The student will:

9.1 Use ratios in calculating nutrient solutions. ½

9.2 Use flow rates to determine the amount of nutrients fed to plants. ½

9.3 Use flow rates to determine greenhouse heating and cooling requirements. ½

9.4 Apply algebraic and calculus equations in calculating pesticide and nutrient formulations.

9.5 Use statistics for figuring germination rates, growth rates, production rates and taking quantitative samples.

Science:

The student will:

9.6 Relate nutrient elements to the periodic table. ½

9.7 Relate plant growth requirements to photosynthesis. ½

9.8 Use the scientific method for testing the success of new techniques.

9.9 Apply chemistry techniques in water quality testing, pH testing and nutrient testing.

9.10 Apply entomology and pathology in pest identification.

9.11 Apply biology, entomology, and botany in biological pest control.

Language Arts:

The student will:

9.12 Synthesize data and research to make presentations on the viability of hydroponics production.

9.13 Refine public speaking and debate skills in developing presentations on hydroponics production.

9.14 Perfect writing skills in developing agriculture papers, publications and demonstrations on hydroponics production. ½

Evidence Standard is Met:

The student will:

- Utilize mathematical skills in calculating flow rates, nutrient solutions, pesticide formulations and plant growth and production rates.
- Use the periodic table to list the required nutrients for hydroponics plant production.
- Apply the scientific method in problem solving applications.
- Identify the major pests, which infest hydroponics crops.
- Use language skills in writing papers, demonstrations, speeches or giving tours.
- Discuss trends in society and governmental policies as they apply to hydroponics.
- Incorporate business, marketing and industry in determining market availability, price, supply, and demand.

Integration/Linkages

Mathematics, Biology, Chemistry, Language arts, Social Studies, Business, Marketing, Horticulture Industry Standards, SCANS (Secretary's Commission on Achieving Necessary Skills)

Sample Performance Tasks

- Describe the sixteen nutrients on the periodic table required for hydroponics plant growth and their functions.
- Compare and contrast major pests, which infest hydroponics crops, and determine appropriate control practices.
- Develop a scientific paper tracking the production rates of hydroponics crops.
- Use algebraic functions to determine the parts-per-million (PPM) and ounces-per-gallon of nutrient solutions and pesticide formulations.

Standard 10.0

The student will develop premier leadership and personal growth in the area of hydroponics crop production.

Learning Expectations:

The student will:

10.1 Demonstrate public speaking abilities.

10.2 Develop SAEP, supervised agricultural experience program, projects incorporating hydroponics. ½

10.3 Develop public relations and citizenship skills necessary to communicate effectively with the public.

10.4 Develop favorable industry work ethic and teamwork skills. ½

10.5 Recommend possible career options available in the field of hydroponics. ½

10.6 Assess professional organizations that represent hydroponics industries.

Evidence Standard is Met:

The student will:

- Develop an imaginary SAEP project incorporating hydroponics.
- Prepare a six-minute speech on hydroponics.
- List favorable work ethic traits desired by profession organizations of hydroponics industries.
- Describe different careers in hydroponics.
- Develop a group presentation on hydroponics.

Integration/Linkages

Mathematics, Science, Social Studies, Language Arts, Business, Marketing, Horticulture Industry Standards, SCANS (Secretary's Commission on Achieving Necessary Skills), National FFA Guidelines for Proficiency Awards and Degrees, National FFA Code of Ethics, National FFA Guidelines for Community Education Programs

Sample Performance Tasks

- Develop a hydroponics tour for a group visiting the facility.
- Develop a portfolio of hydroponics enterprises for an SAEP.
- Present a six-to-eight minute speech on hydroponics.
- Prepare a skit illustrating favorable work ethics.
- Present a two-to-three minute extemporaneous speech on hydroponics.
- Complete a FFA proficiency application related to hydroponics.
- Complete an application for an advanced degree in the FFA.
- Participate in FFA PALS program.
- Participate in Food for America Program.
- Participate in FFA Partners for a Safer Community.
- Participate in Farm Safety Just 4 Kids.
- Participate in America Reads Challenge.